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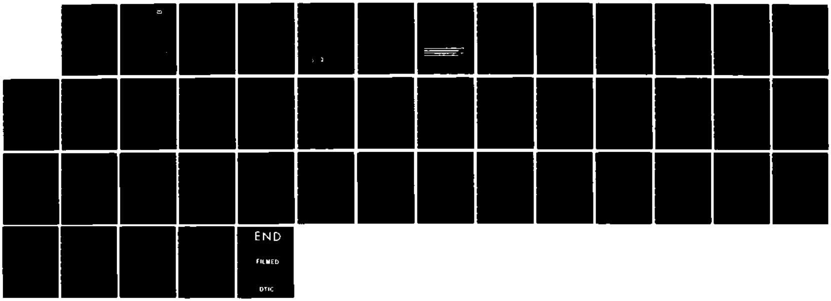

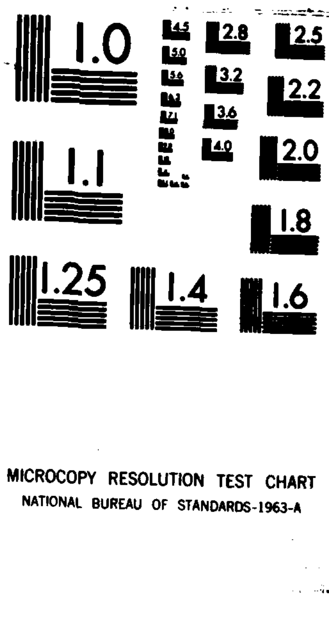

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Special Report 85-1

March 1985

US Army Corps of Engineers
Cold Regions Research & Engineering Laboratory

Catalog of Corps of Engineers structure inventories suitable for the acid precipitation–structure materials study

C.J. Merry, H.L. McKim and N.H. Humiston

Prepared for
US ENVIRONMENTAL PROTECTION AGENCY

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This report contains a survey of Corps of Engineers floodplain inventories. Its purpose was to determine if enough building materials information was available in the Corps data base to be used for predicting the distribution of building materials across the country as part of the EPA acid rain assessment program. The floodplain surveys were rated using the criteria of the date of the survey, the number of buildings, the variety of building materials, the amount of dimensions data listed for the buildings, the land cover types in the data, and whether or not the data were computerized. Six structure inventories were recommended for further study.

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PREFACE

This report was prepared by Carolyn J. Merry, Geologist, Dr. Harlan L. McKim, Research Physical Scientist, and Nancy H. Humiston, Physical Sciences Technician, Earth Sciences Branch, Research Division, U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire. The research has been funded as part of the National Acid Precipitation Assessment Program by the U.S. Environmental Protection Agency, reimbursable order number DW 21930284-01-0.

The authors extend their appreciation to Perry LaPotin (Dartmouth College) for his assistance in placing the structure inventory data into a computer format compatible with the SPSS (Statistical Package for the Social Sciences) program and for his useful technical discussions, and to the many individuals in the U.S. Army Corps of Engineers Division and District offices (see Table 1) who provided the structure inventory information for this report; without their cooperation and assistance, this study would not have been possible. The authors also thank Richard K. Haugen (CRREL) and George Rosenfield (U.S. Geological Survey) for technical review of this report.

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C.J. Merry, H.L. McKim and N.H. Humiston

INTRODUCTION

To estimate the cost of damage to structural materials (in roofs, walls, etc.) caused by acid deposition, one must determine the amount and location of these materials. The magnitude of the existing material surfaces makes an actual inventory prohibitively expensive. However, ancillary data are readily available that could be used to indirectly determine the distribution of building material types. A study of St. Louis and Baltimore has shown that the amounts of different material surfaces (bricks, concrete, etc.) on buildings are correlated with land use and population density at the census tract level (Koontz et al. 1981). More information is needed, however, to satisfactorily explain observed regional differences.

Planning Divisions in the Corps of Engineers have conducted structure inventories in many urban areas in connection with their flood prediction and control efforts. The current practice in many District offices is to separately inventory individual structures by flood frequency zones for flood damage calculations. The data that are usually collected and recorded to characterize each structure include: the structure's identification, damage reach, reference flood elevation, stage-damage function, structure reference elevation, damage category (land use), and structure material types and dimensions. These data are used in a Corps of Engineers program called SID (Structure Inventory for Damage Analysis) to analyze potential damage to individual structures (Hydrologic Engineering Center 1982). A typical data sheet used by the Corps to format the data for the SID program is shown in Figure 1.

In some instances the structure inventories are conducted using a spatial analysis approach. This approach produces an areal analysis of damage

STRUCTURE SURVEY FIELD FORM

STUDY: ____________________

DATE: ____________________

PREPARED BY: ____________________

RESIDENT: ____________________

ADDRESS: ____________________

CITY: ____________________

ZIP: ____________________

RIVER MILE: ____________________

BUILDING ID(IBLDG): ____________________

DAMAGE REACH(IDRCH): ____________________

DAMAGE CATEGORY(IDCAT): ____________________

REF FLOOD ELEV(ADJ): ____________________

STRUCTURE REF ELEV(STOPO): ____________________

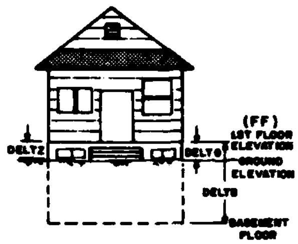
COORDINATES: NORTH (ROW): ____________________

EAST (COLUMN): ____________________

DELTZ (ZERO DAMAGE ELEV-FF): ________

DELTB (BASEMENT-FIRST FLOOR): ________

DELTG (FIRST FLOOR-STOPO): ________



LOCATION	DAMAGE TYPE	VALUE	DAMAGE FUNCTION
ABOVE FIRST FLOOR	STRUCTURE (IDAS)		
	CONTENTS (IDAC)		
	OTHER (IDAO)		
FIRST FLOOR	STRUCTURE (ID1FS)		
	CONTENTS (ID1FC)		
	OTHER (ID1FO)		
BASEMENT	STRUCTURE (IDBS)		
	CONTENTS (IDBC)		
	OTHER (IDBO)		

REMARKS: ____________________

DATA CARDS

1	2	3	4	5	6	7	8	9	10

Columns 1–80

SL: ID | IDRCH | IBLDG | ROWN | COLE | ADJ | STOPO | DELTZ | DELTB | DELTG

SD: ID | IDRCH | IBLDG | IDCAT | ID1FS | V1FS | ID1FC | V1FC | ID1FO | V1FO | IADDR →

SC: ID | IDRCH | IBLDG | IDBS | VBS | IDBC | VBC | IDBO | VBO | IDAS | VAS | IDAC | VAC | IDAO | VAO

SS: ID | IDRCH | IBLDG | YC | SF | TG | C | G | N | G | B | G | B | T | B | C | B | S | WA | B | W | B | OA | B | OB | F | FC | WA | F | W | D | F | OA | F | OD | F

ID | IDRCH | IBLDG | RESID → | ADDR → | CITY → | IZIP

Figure 1. Structure survey field form (after Hydrologic Engineering Center 1982).

potential for a selected grid cell size. The DAMCAL (Damage Reach Stage-Damage Calculations) computer program is used in this case (Hydrologic Engineering Center 1979). The SID and DAMCAL programs are part of the HEC-SAM (Hydrologic Engineering Center-Spatial Analysis Methodology) system -- a spatially oriented data bank used with a number of data management and analysis computer programs.

The structure data bank of the Corps of Engineers is an existing resource that can be used to determine the relationship of material type to land use with minimal field work. It is maintained in a spatial format and can be readily integrated with digital land cover and census tract data.

The distribution of materials over a large geographic area may be estimated using land use and census tract data. A coefficient can then be calculated for each land use type and census tract. With such "materials distribution coefficients" in hand, the amount and location of materials can be readily calculated for the entire country using the U.S. Geological Survey (USGS) land use data base (see Mitchell et al. 1977) and the census tract information.

The purpose of this report is to describe Corps of Engineers structure inventories in the northeastern United States that could be used in a study to develop building materials coefficients for the Acid Deposition Structure Materials Inventory (ADI). Recommendations on which structure inventories would be most suitable for a detailed materials distribution study were developed as a result of this survey.

APPROACH

The Corps Divisions and Districts that were queried for this report are listed in Table 1. The boundaries of each Division and District are shown in Figure 2. Much of the survey information was obtained by telephone contact with representatives in each of the Districts in the Northeastern United States to determine the availability of structure inventories. Information from the New England Division (NED) was obtained directly from flood damage inventory data sheets at the Division.

The items surveyed in each District are shown in Table 2. Data on structure age are unavailable from the Corps data base. The points that are most important to the ADI include the types of building materials listed in the survey, the dimensions of the building and the number of stories, an es-

Table 1. Districts that were queried concerning structure inventory data and contact people in each.

New England Division	Richard Ring, Diane Halas, Jim McLaughlin
North Atlantic Division	
Baltimore District	Ken Hartzel, Charley Yoe
New York District	Norman Blumenstein (Fire Island Inlet Study)
	Robert Callegari, Cathy Revicki (Passaic study)
Norfolk District	Charles Hicks
Philadelphia District	Gary Rohn, Russell Yaworsky
North Central Division	
Buffalo District	Joseph Jarnot
Chicago District	Carl Hessel, Philip Burnstein
Detroit District	Don Woodley, Joe Wanielista
Rock Island District	Chuck Farnhum, Paul Soyke
St. Paul District	Bob Northrup, Chuck Workman
Ohio River Division	
Huntington District	Al Elberfeld
Louisville District	Fred Bennett, Larry Montgomery
Nashville District	Douglas Radley
Pittsburgh District	Henry Edwardo
Lower Mississippi River Valley Division	
St. Louis District	Dave Rahubka

timate of the number of buildings in each community, maps and photographs available as resource materials, and the format of the structure inventory (computerized or data sheets). The survey was limited to structure inventories completed since 1970.

The information obtained from each District includes the year that the inventory was completed, the number of buildings, the relative frequency with which building dimensions and materials were recorded, the building materials and land cover categories, the format of the data, and available ancillary data (Table 3).

We entered the data listed in Table 3 into the computer and processed them using SPSS. The frequency distribution of each variable is shown in Appendix A. Appendix A is useful in that means, variances and frequencies are listed for all the structure inventories, giving a relative overview of the data available in the Corps structure inventories.

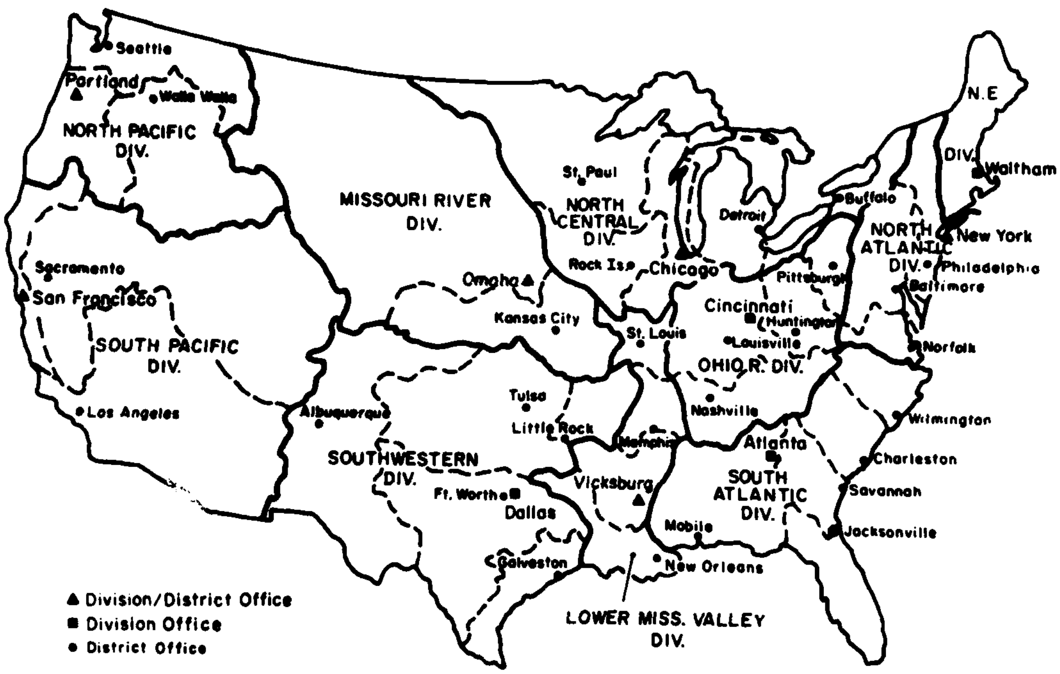


Figure 2. Boundaries of the Corps of Engineers Divisions and Districts.

Table 2. Items taken from the Corps of Engineers structure inventory data.

River basin (and size)
Watershed (and size)
River or damage reach (and size)
Number of buildings inventoried
Types of building materials categorized
Photographs of buildings available
Visual description (appearance/condition) of buildings
Year of inventory
Size dimensions (or no. stories) of buildings
Data format (computer or data sheets)
Available maps and scale
Available aerial photography (scale and data flown)
Land cover categories used in inventory
Cost of data, if required

Table 3. Summary of information from the structural materials inventories.

Inventory	Year of inventory	No. of bldg.	Bldg. dimensions[a] Horizontal	Vertical	Building material[b]	Land cover categories[c]	Data format[d]	Available ancillary data[e]
			New England Division					
Connecticut								
Danbury (Still R.)	1982	82	2	3	B,C,W	C,I	D	-
East Hartford (Conn. R.)	1977	1222	2	2	B,C,W	C,I,P,R,T	D	M
Hartford, Wethersfield (Folly Brook)	1975	181	1	3	B,W	C,P,R	D	Mb
New Milford (Wepawang R.)	1983	84	3	1	B,C,Sh,W	C,P,R	D	-
Stamford (Rippowam R.)	1977	313	4	4	B,C,W	C,Br,P,R	C	AP, P
Thamesville, Norwich (Thames R.)	1979	124	3	3	B,C,W	C,I,R	D	M
Maine								
Fort Fairfield (Aroostook R.)	1977	398	3	3	A,B,W	B,C,I,P,R	D	-
Fort Kent (St. John R.)	1973	128	2	3	B,C,W	C,P,R	D	Mb
Massachusetts								
Pittsfield (Pittsfield R.)	1979	300	0	2	B,C,W	Br,C,I,P,R,T	D	M
Quincy (Black Creek)	Post 1970	380	2	0	B,W	C,I,P,R	D	Mb
Quincy (Town Brook)	1980	461	2	3	B,C,W	C,I,P,R	D	M
Revere (On Coast)	1983	1500	5	5	B,C,M,W	C,R	C	AP,Mb,Pt
Saugus (Saugus R.)	1982	91	3	3	B,C,W	C,I,R	D	M

a - Building dimensions: Relative frequency with which building dimensions were indicated in Corps flood damage surveys. Scale: 0 (never) to 5 (always).

b - Building material types: A = Aluminum siding; B = Brick, C = Cement; G = Glass; M = Metal; Ma = Masonry; N = Nonmasonry; O = Other; P = Painted surfaces; S = Stucco; Sh = Shingles; Sn = Stone; St = Steel; T = Mobile home; W = Wood.

c - Land cover categories: B = Barns, stables; Br = Bridges; C = Commercial; I = Industrial; M = Municipal; O = Other; P = Public; R = Residential; T = Transportation.

d - Data format: C = Computerized; D = Data sheets.

e - Available ancillary data: AP = Aerial photographs; M = Maps; Mb = Maps of area with building locations referenced on them; P = Photographs of representative buildings in a survey area; Pt = Photographs of every building surveyed.

f - Building dimensions: The remainder of the structure inventories were rated as 5 (information available) or 0 (information not available)

g - N/A = Information not available.

Table 3 (cont'd).

Inventory	Year of inventory	No. of bldg.	Bldg. dimensions[a] Horizontal	Vertical	Building material[b]	Land cover categories[c]	Data format[d]	Available ancillary data[e]
Springfield (Conn. R.)	1979	1365	1	2	B,C,W	C,I,P,R,T	D	M
W. Springfield (Conn. R.)	1979	1370	2	3	B,C,W	C,I,P,R	D	Mb,P
Westfield (Westfield R.)	1974	2454	3	3	A,B,C,G, M,S,Sh, St,W	C,I,P,R	D	M
New Hampshire								
Winnipesaukee River	1979	139	2	1	A,B,C,M, Ma,P,S, Sh,St,W	C,I,P,R,T	D	M,P
Rhode Island								
Cranston (Pocasset R.)	1980	168	3	0	B,C,Ma,W	C,I,R	D	Mb
Cranston-West Warwick-Coventry (Pawtuxet R.)	1974	1030	2	3	B,C,Ma,W	C,I,P,R	D	-
Providence (Mohassuck R.)	1977	153	3	3	A,B,C,W	C,I,R	D	-
Providence (Woonasquatucket R.)	1977	276	3	2	B,C,W	C,I,P,R	D	-
North Atlantic Division								
Baltimore District								
North Branch of the Susquehanna River	1978-81	1,600	5	5[f]	N/A[g]	C,O,R	C	Mb,Pt
New York District								
Fire Island Inlet to Montauk Point	1982-83	50,000	5	5	Ma,N	N/A	C	AP,Mb,P
Passaic River Basin	1978-79	48,000	5	5	A,B,C,M, S,Sn,W	N/A	C	AP,Mb
Philadelphia District								
Main Stem of Delaware River	1980-81	12,000	5	5	B,Ma,St, T,W	Br,C,I,M, O,P,R,T	C	AP,M,P
North Central Division								
Chicago District								
Chicago area, Illinois	1982-83	10,700	0	0	N/A	C,I,O,P,R,T	C	M,P
Detroit District								
Clinton River Basin	1981	47,000	0	5	A,B,O,T,W	C,I,M,O,R	C	Mb,P
Shiawassee Flats	1982	1,680	0	5	A,B,O,T,W	R,I,C	D	M
Vassar, Michigan	1982	300	0	5	A,B,O,T,W	R,I,C	D	M
Ohio River Division								
Louisville District								
Frankfort, Kentucky	1979	500	0	5	B,S,Sn,W	C,I,P,R	D	Mb
Hazard, Kentucky	1982	1100	0	5	B,S,Sn,W	C,I,P,R	C	Mb
Henderson, Kentucky	1980	500	0	5	B,S,Sn,W	C,I,P,R	C	AP,Mb

Table 3 (cont'd). Summary of information from the structural materials inventories.

Inventory	Year of inventory	No. of bldg.	Bldg. dimensions Horizontal	Bldg. dimensions Vertical	Building material[b]	Land cover categories[c]	Data format[d]	Available ancillary data[e]
Jeffersonville, Indiana	1983	1600	0	5	B,S,Sn,W	C,I,P,R	D	Mb
Kettering-Moraine, Ohio	1983	500	0	5	B,S,Sn,W	C,I,P,R	C	Mb
Nashville District								
Browns Creek	1983	425	0	5	B,Ma,M,W	C,R	D	Mb,P
Mill Creek drainage basin	1983	103	0	5	B,Ma,M,W	C,R	D	Mb,P
Pittsburgh District								
New Martinsville, West Virginia	1983	1,250	5	5	B,S,Sn,W	C,I,R	C	Mb,AP

In Table 3, the relative frequency with which building dimensions and materials information was recorded in each NED structure inventory, was given a score of 0 (never) to 5 (always) based on a review of the inventory files. This allowed for quick assessment of available data. Dimensions and materials information in inventories from other Districts was also rated in the same way, but the scores were based on information received over the telephone from District representatives.

To evaluate the usefulness of individual flood damage inventories to this building materials study, we developed a rating table using the information obtained from each District (Table 4). Specific criteria, which are described below, were used to rate the most important factors in the inventories. The sum of the ratings of each of these factors was used to compare the individual structure inventories in terms of their utility to the ADI.

The information on building materials in Table 3 was combined with other knowledge to rate the usefulness of the building materials information in each structure inventory. The following scale was used to rate the building materials factor:

5. Building materials are listed consistently throughout the survey.

4. Photographs are available for each structure so that building materials could be determined.

3. Representative photographs are available or the building materials are listed for a representative number of buildings, so material type could be estimated.

2. Building materials are sometimes reported or some photographs are available, but more information is required; field sampling would be necessary.

1. Building materials are unknown; building materials would have to be established based on field sampling or knowledge of the area.

Building dimensions scores from Table 3 were evaluated to rate the usefulness of the building dimensions information. Horizontal dimensions (length and width) were given more emphasis than were heights of buildings because if length and width are known, it would be possible to estimate height based on the structure type. We considered knowing the actual height of a building more useful than knowing only the number of stories. The criteria for building dimensions information are shown below:

5. Length, width and height of buildings are given.

4. Length and width are recorded consistently; height would have to be estimated from number of stories.

3. Length and width are usually available; the number of stories is not given, so a reasonable estimate of building height would have to be made.

2. Length and width are not recorded or not regularly recorded; building height would have to be estimated based on the number of stories of the structure.

1. Dimensions are recorded rarely or not at all; standard building size would have to be estimated based on land cover type.

In the study of individual NED flood damage inventories, we found that building dimensions and building materials were sometimes not recorded for each building because that information is not required for estimates of potential flood damage. This is an important factor in the usefulness of an inventory to the ADI, hence the consistency with which building materials and dimensions were reported in each inventory was evaluated for NED inventories.

The criteria for the land cover mix factor are based on a useful mixture of land cover categories for the overall study. In the inventories studied, a good mix consisted of 75% residential and 25% commercial and industrial structures. In most cases, for the NED inventories, the commercial category includes industrial buildings. Therefore, the following general criteria were established:

5. 75% residential : 25% commercial or industrial.

4. 81 - 90% residential : 10 - 19% commercial or industrial.

3. 50% residential : 50% commercial or industrial.

2. Greater than 90% residential : less than 10% commercial or industrial.

1. Less than 25% residential : greater than 75% commercial or industrial.

The criteria for the data format factor are based principally on whether the data were computerized or not and how easily the information could be merged into a data base management system. We used the following criteria:

5. Structure data are computerized and the location information is easily adaptable to a geographic information system.

4. Data are adaptable to a geographic information system because the structure locations are indicated on maps; the data are not computerized.

3. Structure locations are not indicated on maps; structure data are computerized; structures are spatially located only by street addresses.

2. Structure locations are not indicated on maps; structure data are computerized; structures do not have street address labels.

1. Same as 2 except data are not computerized.

RESULTS

Information on flood damage surveys that was obtained from Corps of Engineers Divisions in the Northeastern U.S. is described in Table 3. Also, the ratings applied to the four factors in each survey are explained in Table 4. In the following, the survey results are usually presented by Division, District and area of inventory (e.g., community, watershed or general area). The results from NED, however, are presented by state and area of individual inventory.

New England Division

New England Division conducts flood damage inventories in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut. In a preliminary examination of the structure inventory files, we found that approximately 40 inventories have been completed since 1970. Further study showed

Table 4 (cont'd). Structure materials inventory rating scale (5-20).*

Inventory	Material types	Building dimensions information	Land cover mix	Data format	Total
		New England Division			
Connecticut					
Danbury	5	2	1	3	11
East Hartford	2	1	5	3	11
Hartford	1	2	2	4	9
New Milford	5	3	1	1	10
Stamford	5	4	5	3	17
Thamesville	3	3	4	3	13
Maine					
Fort Fairfield	3	3	5	3	14
Fort Kent	3	2	3	4	12
Massachusetts					
Pittsfield	1	1	4	3	9
Quincy, Black Creek	1	1	2	3	7
Quincy, Town Brook	5	2	5	4	16
Revere (Coastal city)	5	4	4	5	18
Saugus	3	3	5	3	14
Springfield	1	1	5	3	10
West Springfield	2	2	3	3	10
Westfield	3	3	5	3	14
New Hampshire					
Winnipesaukee River	5	2	3	3	13
Rhode Island					
Cranston, Pawtuxet River	3	1	4	3	11
Cranston, Pocasset River	3	3	2	4	12
Providence, Mohassuck River	2	3	3	3	11
Providence, Woonasquatucket River	2	2	3	1	8
		North Atlantic Division			
Baltimore District					
North Branch of the Susquehanna River	4	4	4	5	17
New York District					
Fire Island Inlet to Montauk Point	3	4	2	5	14
Passaic River Basin	5	4	3	5	17
Philadelphia District					
Main Stem of the Delaware River	5	4	3	5	17

*The rating criteria are explained in the Approach section of the text.

Table 4 (cont'd). Structure materials inventory rating scale (5-20).

Inventory	Material types	Building dimensions information	Land cover mix	Data format	Total
		North Central Division			
Chicago District					
Chicago area	2	1	1	4	8
Detroit District					
Clinton River Basin	5	2	3	3	13
Shiawassee Flats	5	2	3	4	14
Vassar, Michigan	5	2	3	3	13
		Ohio River Division			
Louisville District					
Frankfort, Kentucky	5	2	3	4	14
Hazard, Kentucky	5	2	3	4	14
Henderson, Kentucky	5	2	3	4	14
Jeffersonville, Indiana	5	2	3	4	14
Kettering-Moraine, Ohio	5	2	3	4	14
Nashville District					
Browns Creek	5	2	5	4	16
Mill Creek drainage basin	5	2	5	4	16
Pittsburgh District					
New Martinsville, West Virginia	5	4	5	5	19

that 21 of the inventories could be considered for use in the ADI. Our overall ratings of the NED inventories ranged from 7 to 18 (comparable to all inventories considered in this report). All 21 inventories are discussed below. A more detailed description of the characteristics summarized in Table 3 and an explanation of the ratings assigned in Table 4 will be given only for the 11 inventories with ratings higher than 7 that were suitable for the ADI.

Four points should be noted about the NED inventories. First, building height is almost always indicated by number of stories, not units of measurement. Second, most inventories reported three building material categories: wood, brick and cement. When other materials were reported, this is stated in the discussion. Third, addresses are available for almost all buildings in every NED inventory. Since it is necessary to spatially locate

buildings for the ADI geographic data base, this would be useful. In some cases, building locations are already referenced on maps. This would be even more valuable in the ADI. Finally, there are two computerized inventories (Revere, Massachusetts and Stamford, Connecticut) that often have spatial references for each building.

Connecticut

Flood damage inventories were taken in Danbury, East Hartford, Hartford, New Milford, Stamford and Thamesville. We rated only three higher than 10. Stamford, which received a rating of 17, was the only computerized inventory in Connecticut.

In the Danbury inventory (overall rating of 11) building dimensions are recorded consistently and building materials are recorded very consistently. It is a small survey (82 structures), including 37 industrial and 45 commercial structures. The small size, and the lack of any residential land cover, limits the usefulness of this inventory to the ADI.

East Hartford, on the Connecticut River in central Connecticut, has an inventory (overall rating of 11) that contains 1222 structures (923 residential, 223 commercial, 39 industrial and 28 public). Information on building dimensions and materials received low ratings because they are only reported for some of the structures and there are no photographs of buildings that could be used to get this information indirectly. Data are stored on data sheets and there are no maps of building locations. The address of every building is available in this inventory, so it would be possible, although difficult, to locate each building in a geographic data base.

The Hartford - Wethersfield inventory received an overall rating of 9. Building materials and horizontal building dimensions are rarely reported, but the number of stories is usually given. There are 175 residential and 5 commercial buildings listed in this survey. This inventory is stored on data sheets, and buildings in the inventory are located on maps, so it would be possible to create a geographic data base.

The inventory done in New Milford received a rating of 10. The low rating is partly attributable to a land cover mix ratio of 30 residential to 70 commercial buildings, and data sheets are missing. Only 84 structures were inventoried.

Stamford is located on the north shore of Long Island Sound, 7 miles east of the New York State line, where the Rippowam River runs into the west

branch of Stamford Harbor. The Stamford inventory (200 residential, 100 commercial and 5 public buildings) is one of two at NED that is stored in a computer. The data were recorded manually on flood damage survey forms, then were keypunched onto IBM computer cards. Either the data sheets or the IBM cards could be used in the ADI. Advantages of the computerized system are that data can be manipulated more efficiently and information is recorded more systematically. The computer program used to store the Stamford inventory is not an interactive system, so it would be necessary to consider computer programming, processing and storage costs if this inventory is used.

The original data sheets for Stamford were not accessible; however, building materials and size are recorded most of the time.* Building materials were recorded under the categories of wood, brick or cement. The land cover mix ratio is approximately 75 residential to 25 commercial. Although this is a computerized survey, there is no spatial referencing of buildings. Aerial photographs of the area and photographs of representative houses are available.

A small-scale inventory was done at Thamesville (overall rating of 13), covering an area 15 miles upstream of Long Island Sound at the head of the Thames River. Although the inventory is small (104 residential, 12 commercial and 8 industrial buildings), the land cover mix is good. Building size and materials information are often recorded. However, the information is recorded only on data sheets, and building locations are not referenced on maps.

Maine

Two inventories done in Maine can be considered for use in the ADI. Both received ratings above 10.

Fort Fairfield (overall rating of 14) is located in the northeastern section of the state on the Aroostook River. The information, collected by a private consulting firm, is consistent, detailed and organized. This survey is unique in that it covers a rural area and includes information on 56 barns and stables; this may be more representative of rural New England than are other inventories. There are also 259 residential, 76 commercial, 2 industrial and 2 public structures. The residential-to-commercial ratio is

*Personal communication with D. Halas, NED, 1983.

65:35. However, building locations are not marked on maps. Building materials mentioned include wood, brick and aluminum.

The overall rating for Fort Kent is 12. This inventory consists of 128 structures (50 residential, 70 commercial, 8 public) located in northern Maine, west of Fort Fairfield, on the St. John River. The land cover ratio is approximately 40 residential to 60 commercial. Horizontal dimensions are not recorded as consistently as they are in the Fort Fairfield inventory, but the number of stories is usually given. Building materials are usually listed, and the information is stored on data sheets and building locations are marked on maps.

Massachusetts

Eight inventories from this state are listed in Table 4. Their ratings range from 10 to 18. Revere, a computerized inventory, received the rating of 18.

The Pittsfield inventory (overall rating of 9) is not as well organized as other inventories. Data sheets are missing and building information is less consistent and detailed than it is in other inventories. The Quincy - Black Creek inventory (overall rating of 7) had little or no dimensions and materials information and a poor land cover mix (98 residential to 2 commercial). The Springfield and West Springfield inventories each received overall ratings of 10, largely because of incomplete dimensions and materials information. Springfield has a good land cover mix ratio (70 residential to 30 commercial). Zoning maps are available for some areas of West Springfield; building locations are marked on these maps.

The Quincy - Town Brook inventory received an overall rating of 15. It is well organized. Quincy is an urban-suburban area southeast of Boston on Massachusetts Bay. Building materials information and land cover mix ratio (75 residential to 25 commercial) each were excellent. The land cover distribution includes 350 residential, 100 commercial, 8 industrial and 3 public structures. Although the number of stories is usually given, horizontal dimensions are only occasionally reported. Building locations are referenced on a map.

Revere (overall rating of 18) is an urban-suburban coastal community located northeast of Boston. Information in this inventory was originally recorded manually on survey forms; the data were then keypunched onto computer cards. The program is somewhat interactive (more than the program used in the Stamford, Connecticut, survey).

The method used to describe residences in this survey is unique among the NED inventories. Fifteen categories were devised, including, for example, small, one story, one family, no basement; medium, two story, two family, unfinished basement; etc. Each residence was put into a category. Information on building size could be derived from these categories because height is given consistently in number of stories. Building materials were routinely recorded using four categories: wood frame, brick, cement and other. Aerial photographs or maps derived from aerial photographs of the area are available, as are photographs of every building in the survey.* Addresses of buildings are recorded on the maps. The land cover mix (1300 residential, 200 commercial) ratio is 85:15. However, this coastal community may not be representative of other New England areas.

There are 91 structures in the Saugus inventory (overall rating of 14). Although the land cover ratio is good (70 residential to 30 commercial), it may be too small a sample for the ADI.

The Westfield inventory (overall rating of 14) is, on the whole, one of the best organized and most complete of the uncomputerized NED inventories. There are 2454 structures in the inventory (1969 residential, 399 commercial, 41 industrial, 45 public), and the land cover ratio is 80 residential to 20 commercial. The building dimensions and materials information are usually reported for each. An unusually wide variety of materials was recorded on the inventory forms, including aluminum siding, brick, cement, glass, metal, stucco, shingles, steel and wood. However, the inventory is not computerized, and buildings are not located on maps.

New Hampshire

The only inventory in this state that could be useful in the ADI was done along the Winnipesaukee River (overall rating of 13). It is a relatively small inventory (139 structures) with a land cover ratio of 50 residential to 50 commercial. There are also a few industrial and public buildings. The building materials and dimensions information differs in consistency; on residential inventory forms, building materials and number of stories are almost always recorded, but there are no horizontal measurements given at all. On the forms used to describe other land cover categories, building materials are usually reported, but the number of stories and the

* Personal communication with J. McLaughlin, NED, 1983

horizontal dimensions are rarely reported. Photographs of many buildings are available. A large number of materials were reported, including aluminum siding, brick, cement, metal, masonry, painted surfaces, stucco, shingle, steel and wood. The data are not computerized and building locations are not referenced on maps.

Rhode Island

Inventories completed in four areas are described here; ratings range from 8 to 12.

The Cranston - Pocasset River inventory (overall rating of 12) consists of 168 structures (156 residential, 7 commercial, 5 industrial). Information is not reported on every structure. Instead, reports are made on small sample areas within the inventory area. Masonry is sometimes listed along with the standard materials categories. The land cover ratio is 95 residential to 5 commercial, and building locations are referenced on maps.

The inventory taken at Cranston - Pawtuxet River (overall rating of 11) is larger than the Cranston - Pocasset River inventory (831 residential, 133 commercial, 62 industrial and 4 public structures). There is little information on horizontal building measurements. Material types are usually reported and include masonry and glass as well as the typical wood, brick and cement categories. Building locations are not marked on maps.

The Providence - Mohassuck River inventory (overall rating of 11) consisted of 40 residential, 92 commercial and 21 industrial structures. Building dimensions information was consistently reported, but building materials were not frequently reported. Building locations were not referenced on maps.

The Providence - Woonasquatucket River inventory (overall rating of 8) consists of 91 residential, 120 commercial, 60 industrial and 5 public structures. However, because building materials and dimensions information is reported so inconsistently and addresses of all structures are not available, this inventory should not be considered for the ADI.

North Atlantic Division

Baltimore District

In the Baltimore District there were several structure inventories for communities along the north branch of the Susquehanna River that were suitable for our purpose. The communities and dates of the structure inventor-

ies included: Unadilla, New York (1978-79); Conklin Station, New York (1981-82); Julius Rodgers School area, New York (1981); Kirkwood, New York (1981-82); Broadacres, New York (1978-79); Coopers Plain (Erwins), New York (1981); Marathon, New York (1978-79); and Cortland, New York (1978-79). The characteristics of each structure inventory are shown in Table 3. Although building materials were not noted in these structure inventories, photographs were taken of each structure. Using the photographs, we could determine the building material type of each structure.

The building material type was not surveyed in this District because the building exterior was found to be insignificant in flood damage calculations. Approximately 10% of the 1600 structures were in the commercial land use category. Maps that show the location of the structures in the floodplain are available. Each of the structures is numbered and keyed to a photograph and a line of data in a computerized structure information file.

The building dimensions data (length, width) of each structure are in the computer file, as is the number of stories, so the building height could be estimated. The land cover mix was suitable for our purposes, with approximately 90% residential and 10% commercial structures. Industrial, public use and other land cover types would have to be inferred from the structure type information. The structure information data are already computerized and the maps with the location of the structures would be easily adaptable to a geographic data base.

Other structure surveys were available for several communities located in Pennsylvania and Maryland. However, construction materials were not noted and photographs were not taken of each structure; therefore, these structure inventories were not included in our evaluation.

New York District

There were two major studies in the New York District: one for Fire Island Inlet to Montauk Point along the south shore of Long Island, Suffolk County, New York, and one for the Passaic River Basin, New Jersey. In the Fire Island Inlet study, every structure was inventoried up to an elevation of 16 ft above National Geodetic Vertical Datum. The locations of the structures are keyed to maps. Two types of building materials were listed for each structure: masonry (includes brick, stone, stucco) and nonmasonry (includes wood, metal). Approximately 1500 representative photographs of structures are available, and these could be examined to determine the actu-

al building materials. The length, width and number of stories of each structure are included in the computer data file.

The land cover mix is principally single family residential. There are very few multifamily houses and it is not a heavily industrialized area. There is no differentiation of land cover in the data file; the land cover would have to be inferred from the structure type information. The data base is computerized and the structures are keyed to maps.

The Passaic River Basin has approximately 48,000 structures in the floodplain area of the 950-mile^2 drainage basin. The land use for the basin is mapped in 10-acre grid cells, although the structure data file was not formatted to interface with the land cover file. There is approximately a 60% residential to 40% nonresidential mixture of land cover types. The square footage and number of stories were given in the structure data base so a reasonable estimate of surface area could be determined. There were several building materials categories: aluminum siding, brick, metal, stucco, cement, cedar shingles or shakes (wood), and stone. The structure data base information is computerized and there are maps available with the structures located on them.

Norfolk District

There were no suitable structure inventories in the Norfolk District. Generalized curves for one story-two story frame or brick structures are used in their flood damage calculations. Information was not taken on building materials.

Philadelphia District

There were 58 communities comprising 12,000 structures that were inventoried along the main stem of the Delaware River. Building materials were inventoried and included brick, steel, masonry, mobile homes and wood. Photographs were taken of representative buildings. The land cover mix was principally residential with small urban centers. Land use was mapped and coded along with the structure type. The land use types included bridges, commercial, industrial, municipal, public, residential, transportation and other. The building dimensions (length and width) and the number of stories were determined for each structure so the vertical height could be estimated from the number of stories. The data are stored in a computerized format,

there are maps available, and the building locations are referenced on aerial photographs.

The lower part of the Pennypack Watershed was also considered. The land cover is computerized at 3/4-acre grid cells outside of the floodplain and 1/4-acre grid cells within the floodplain. The land cover units included single-family residential, low-density urban, medium-density urban, high-density urban and commercial-industrial. There was no structure-by-structure accounting for this inventory. In this area most homes are either wood frame with aluminum siding or brick veneer, and apartment buildings are normally made of masonry. To use this study, inferences would have to be made about typically constructed buildings and typical materials, with additional field work necessary. Therefore, this inventory was not considered further.

North Central Division

Buffalo District

There were no suitable structure inventories in the Buffalo District. The structure inventories are of existing structures, such as piers and bulkheads, on Lake Erie, Lake Ontario, the Finger Lakes, St. Lawrence Seaway and several rivers. These inventories are taken to support Corps permitting activities.

In 1974 a 100-year floodplain survey was done for the District. The survey was a paper study with very little information on buildings; a questionnaire was sent to the shoreline property users, with questions directed toward erosion problems.

Chicago District

Some 352 $mile^2$ of the Chicago metropolitan area is serviced by sewers, which carry both sanitary wastewater and storm water runoff in a single pipe. Chicago and 51 adjacent communities experience severe flooding problems because of this combined sewer system. The flooding is unique in the sense that basement flooding caused by sewer backup is observable only to the people affected, hence, data are harder to secure. The study concentrates on the sewer backup problem that occurs when either rainfall exceeds sewer capacity or when runoff raises watercourse stages so that the overflow outlets of the sewer system become submerged. The 352-$mile^2$ area has been divided into 204 subareas to facilitate the analysis and computer modeling.

The study area encompasses over 1.4 million housing units and had a 1980 population of over 3.7 million people.

There were 10,700 responses from homes surveyed in sample areas for this particular study. The houses are located on maps and the structural information is computerized. U.S. Geological Survey topographic quadrangles were the base maps for the study. The homes in the residential category are principally single-family residences with or without basements. The basic source of the data are the 1970 and 1980 censuses. Building type was determined by the number of dwelling units given for any single address. It would probably take a field reconnaissance at selected sampling areas to establish the building materials present in the survey.

Other pertinent housing data were obtained from the census information. There were 37 land cover categories mapped in a data base that is computerized with a grid cell size of 1/4-section. Aerial photographs are available for this area. About 30% of the area is residential. There was no information on building dimensions so a standard size house would be required in estimating the building dimensions.

Detroit District

In the Clinton River Basin a detailed structure inventory was done for the Red Run Drain - Lower Clinton River area in Michigan. There were 47,000 structures sampled in 357 damage reaches in a 167-mile^2 area. The data are computerized with structures keyed to a map address, but they would have to be keyed to U.S. Geological Survey 7.5-minute topographic quadrangles. Materials that were categorized on data sheets, but not coded for the computer, included mobile homes, brick veneer, aluminum siding and wood frame. The buildings were principally categorized according to type. The photographs showing representative buildings would have to be used in determining building materials.

Building dimensions were not recorded, so a standard size structure would have to be assumed for calculating building dimensions. There were seven residential categories and five other categories (small commercial, medium commercial including apartment buildings, large commercial, heavy industrial and municipal-exempt). Land use is computerized in 10-acre grid cells. The land cover mix was about 92% residential, 6% commercial and 2% municipal.

An inventory in Vassar, Michigan, and another in Shiawassee Flats are also suitable. There were approximately 300 buildings categorized during 1982 for the Vassar study. Brick veneer, aluminum siding, wood frame, mobile homes and other materials were noted. The land cover mix was principally residential. Information was not given on building dimensions. A standard size structure would have to be estimated based on whether it was a one-story or two-story building. The structures information is listed on data sheets, and they are located by street address, but would have to be keyed to U.S. Geological Survey 7.5-minute topographic quadrangles.

The Shiawassee Flats study area is primarily agricultural, with only a small number of commercial and industrial structures. Building dimensions would have to be estimated based on the typical dimensions for a one-story or a two-story building with or without a basement. The same building materials found in Vassar, Michigan, were listed. Aerial photography was flown in early 1983. The structures were located on the maps prepared from the photography and verified from field surveys; however, the location of structures would have to be determined from the 1-ft contour maps.

Rock Island District

Inventories have been taken in the Rock Island District along the Mississippi and Illinois Rivers and along the tributaries in Iowa, along the Fox River in Wisconsin, and in various scattered communities throughout the District. For the communities, only the structures within the floodplain are inventoried and their numbers vary from 200 to 1000. The largest community inventory is for Rockford, Illinois, with 2000 to 2500 buildings. In the Rock Island District, building materials are considered to have no effect on the flood damages for the residential categories. For the commercial and industrial category, the material type was found to make a difference; however, the building materials are only sometimes noted in the field surveys. The structures are not located on photography or a map, but photographs were taken of typical buildings that are used by the survey teams for categorizing the structures. We determined that there were no suitable structure surveys from the Rock Island District that could be used for our study, since they would need additional field sampling and work to locate structures on a map and to computerize the data base.

St. Paul District

In the St. Paul District the type of building material does not make much difference in the flood damage calculations. Wood frame is the predominant material and the standard is to develop tables relating structure damage to the building value and its elevation. The number of structures are determined for a given location and land cover type. As a practice, photographs of buildings are not taken. Computerized information on structures include data such as first floor elevation, ground elevation, basement or no basement, and whether the building is one-story or two-story. Dimensions of the building are not taken. We determined that because material type was not noted and because there were no available representative building photographs, the structure surveys would not be suitable for our purpose.

Ohio River Division

Huntington District

In the Huntington District there is no systematic inventory of building materials. The square footage and the contents of residential buildings are more important for flood damage surveys. There are representative photographs of building types that are used for confirming flood damage. Detailed topographic mapping is not extensive for flood damage surveys in the District. Normally, U.S. Geological Survey 7.5-minute topographic quadrangles are the base maps used in most studies.

There are some recent aerial photographs of the Kanawha and Ohio Rivers. Accurate maps could be made from these photographs for selected flood damage reaches. A sample would then have to be taken of materials for the residential, commercial and industrial categories. We determined that it would be difficult to locate the structures on a map and to computerize the existing structure information. Field sampling would be necessary to verify building materials. Therefore, we decided that there was not enough existing structure inventory information for our study.

Louisville District

The building materials that were noted in the Louisville District during their structure surveys included brick, stucco, stone, wood frame, or a combination of these materials. There were five surveys done during the last 5 years that could potentially be used in our study, although there

were several additional surveys that could be evaluated also. These included: 1) Kettering - Moraine, Ohio, on the Miami River near Dayton, Ohio; 2) Hazard, Kentucky, on the north fork of the Kentucky River; 3) Frankfort, Kentucky; 4) Jeffersonville, Indiana, on the Ohio River; and 5) Henderson, Kentucky, on the Ohio River. Photographs were not taken of the buildings and dimensions were not noted; therefore, the surface areas of the houses would have to be estimated. The land cover categories that were used included residential, commercial, industrial and public.

Building materials were noted during the surveys. The land cover mix was principally residential, and maps that show the location of structures are available. The structure information is on data sheets so these data would have to be computerized.

Nashville District

The Nashville District obtains information on building materials to include wood frame, brick veneer, concrete block and corrugated metal. Foundation types are also noted and include slate, concrete block, stone, rubble and other foundation material. Two planning projects in the Nashville District have photographs available for every building. The Mill Creek Drainage Basin in the southern part of Nashville has 103 structures and the Browns Creek study has 425 structures. The land cover mix for both areas was 70-80% residential and 25% commercial. The type of structure (one-story, two-story, trailer, other) was noted in the surveys, but length and width were not given, although the number of stories was noted. Maps were available showing the locations of the structures and the structures are keyed to data sheets. The data are formatted to use as input to the Corps SID program.

In the Pineville area of eastern Kentucky, there were 20-30 structures. This project area would be too small for our study so it was not considered in the summary table.

Pittsburgh District

In the 1960's complete structure inventories were taken for communities along the Ohio River. The more recent surveys are being computerized. The Pittsburgh District has recently recommended that all the existing structure inventories be computerized for the Ohio River Main Stem study area.

The District does not have the kinds of information required to direct-

ly determine the surface area of various building construction materials. The District does use tax assessment property data files that are available for most communities. The benefit of this is that the data are not restricted to the floodplain areas. This type of information is used in the Pittsburgh District for updating their structure inventories.

A file index of the property record card system for the New Martinsville area, West Virginia, was examined to see if the pertinent information could be extracted for the building materials inventory study. The following information could be extracted: land cover types, type of building property, square footage of building and the number of stories.

Building materials of brick, stucco, stone and wood could be extracted from the structure information, and the square footage data and number of stories are available, so an estimate of the building dimensions could be made. There are about 85% residential structures and 15% commercial structures in the New Martinsville area. The structure data are computerized and maps with the structures located on them are available.

Lower Mississippi River Valley Division

St. Louis District

The St. Louis District does not categorize building materials. Photographs of buildings were also not taken, so structure materials could not be determined. We found that there was not enough available structures information in the St. Louis District to select potential study sites.

CONCLUSIONS

The following six structure inventories that received the highest ratings are all candidates for further study:

- New Martinsville, West Virginia (19)
- Revere, Massachusetts (18)
- Stamford, Connecticut (17)
- North Branch, Susquehanna River, New York (17)
- Passaic River, New Jersey (17)
- Main Stem of the Delaware River (17).

All of these are computerized data bases. In the Susquehanna, Passaic and New Martinsville inventories, the buildings have spatial references that could be incorporated into the ADI data base. The Passaic River, Revere,

Stamford, Delaware River and New Martinsville inventories have the strongest building materials (each rating of 5) and dimensions (each rating of 4) data. The land cover ratios of all but the Passaic River (rating of 3) inventory are highly rated. It is possible that there are reaches of the Passaic River that have land cover mixes that would be appropriate for the ADI.

RECOMMENDATIONS

We recommend that the structure inventories of Revere, Massachusetts, and Stamford, Connecticut, be used in an initial attempt to develop a building material sample survey. The two cities are located in New England, are of similar size, and are already computerized.

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APPENDIX A: FREQUENCY DISTRIBUTIONS OF STRUCTURE INVENTORY DATA IN SPSS FORMAT

Table A1 lists variable names. When a variable takes a value of 1, this indicates its presence; 0 indicates its absence.

Table A1. Variables (from Table 3).

Variable	Description	Range
YR	Year of inventory	70 (1970) - 83 (1983)
BN	Number of buildings in inventory	1(<181) 2(182-1030) 3(1031-1500) 4(1501-2454) 5(> 2455)
BH	Building horizontal dimension, relative frequency with which building dimensions was indicated in surveys	0-5
BV	Building vertical dimension, relative frequency with which building height was indicated in survey	0-5
BM1	Brick	0, 1
BM2	Cement	0, 1
BM3	Wood	0, 1
BM4	Metal	0, 1
BM5	Glass	0, 1
BM6	Painted surfaces	0, 1
BM7	Masonry	0, 1
LC1	Industrial	0, 1
LC2	Commercial (municipal)	0, 1
LC3	Residential	0, 1
LC4	Other	0, 1
DF	Data format	0 (not computerized), 1 (computerized)

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SPSS BATCH SYSTEM

SPSS                            FOR PRIME 400/500, VERSION M, RELEASE 9.1, AUGUST 1, 1982
                                           CURRENT DOCUMENTATION FOR THE SPSS BATCH SYSTEM
ORDER FROM MCGRAW-HILL:   SPSS, 2ND ED. (PRINCIPAL TEXT)          ORDER FROM SPSS INC.:
                          SPSS STATISTICAL ALGORITHMS
                          KEYWORDS: THE SPSS INC. NEWSLETTER
                          SPSS UPDATE 7-9 (USE W/SPSS,2ND FOR REL. 7, 8, 9)
                          SPSS POCKET GUIDE, RELEASE 9
                          SPSS INTRODUCTORY GUIDE:  BASIC STATISTICS AND OPERATIONS
                          SPSS PRIMER (BRIEF INTRO TO SPSS)
DEFAULT SPACE ALLOCATION..       ALLOWS FOR..    163 TRANSFORMATIONS
WORKSPACE      114688 BYTES                      655 RECODE VALUES + LAG VARIABLES
TRANSPACE       16384 BYTES                     2624 IF/COMPUTE OPERATIONS

                     1 RUN NAME          EPA SELECTION CRITERIA
                     2 PAGESIZE          NOEJECT
                     3 VARIABLE LIST     YR,BN,BH,BV,BM1 TO BM7,LC1 TO LC4,DF
                     4 INPUT MEDIUM      [TABLE3D]
                     5 N OF CASES        35
                     6 INPUT FORMAT      FREEFIELD
                     7 COMPUTE           YRS=(YR-79.3714)/3.2996
                     8 COMPUTE           BNS=(BN-2.6000)/1.3763
                     9 COMPUTE           BHS=(BH-2.1714)/1.7738
                    10 COMPUTE           BVS=(BV-2.2857)/1.4866
                    11 COMPUTE           BM1S=(BM1-0.8660)/0.3230
                    12 COMPUTE           BM2S=(BM2-0.5429)/0.5054
                    13 COMPUTE           BM3S=(BM3-0.8857)/0.3228
                    14 COMPUTE           BM4S=(BM4-0.2571)/0.4434
                    15 COMPUTE           BM5S=(BM5-0.0286)/0.1690
                    16 COMPUTE           BM6S=(BM6-0.0286)/0.1690
                    17 COMPUTE           BM7S=(BM7-0.3143)/0.4710
                    18 COMPUTE           LC1S=(LC1-0.7429)/0.4434
                    19 COMPUTE           LC2S=(LC2-0.9143)/0.2840
                    20 COMPUTE           LC3S=(LC3-0.8857)/0.3228
                    21 COMPUTE           LC4S=(LC4-0.3714)/0.4902
                    22 COMPUTE           DFS=(DF-0.3429)/0.4816
                    23 COMPUTE           ZBM=0.10150*BM2S - 0.09752*((BM1S+BM3S)/2.0)+
                    24                   1.02153*BM4S - 0.08815*BM5S - 0.08815*BM6S+
                    25                   0.15999*BM7S
                    26 COMPUTE           ZLC=0.12864*LC1S + 0.77222*LC2S + 0.15552*LC3S -
                    27                   0.02934*LC4S
                    28 COMPUTE           ZT=-0.01696*YRS+0.25253*BNS-0.09720*BHS-0.20785*BVS
                    29                   -0.13843*BM2S+0.05195*((BM1S+BM3S)/2.0)+0.14463*BM4S
                    30                   -0.09911*BM5S-0.05457*BM6S+0.03516*BM7S+0.02952*LC1S
                    31                   +0.86399*LC2S-0.02067*LC3S-0.04495*LC4S-0.05194*DFS
                    32 COMPUTE           ACS=BH*BV
                    33 COMPUTE           AT=BN*ACS
                    34 PRINT FORMATS     ALL(2)
                    35 READ INPUT DATA

- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

EPA SELECTION CRITERIA

TRANSPACE REQUIRED..      2100 BYTES
     21 TRANSFORMATIONS
      0 RECODE VALUES + LAG VARIABLES
    171 IF/COMPUTE OPERATIONS


                    36 FREQUENCIES       GENERAL=YR TO DF
                    37 OPTION            8
                    38 STATISTICS        ALL
GIVEN WORKSPACE ALLOWS FOR   4096 VALUES AND    4096 LABELS PER VARIABLE FOR 'FREQUENCIES'


- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -

EPA SELECTION CRITERIA

FILE   NONAME   (CREATION DATE = 01/16/84)

YR
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CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	70.00	1	2.9	2.9	2.9
	73.00	1	2.9	2.9	5.7
	74.00	2	5.7	5.7	11.4
	75.00	1	2.9	2.9	14.3
	77.00	5	14.3	14.3	28.6
	79.00	7	20.0	20.0	48.6
	80.00	3	8.6	8.6	57.1
	81.00	3	8.6	8.6	65.7
	82.00	5	14.3	14.3	80.0
	83.00	7	20.0	20.0	100.0
	TOTAL	35	100.0	100.0	

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
```

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

YR

```
    CODE
           I
   70.00   ****** (       1)
           I
           I
   73.00   ****** (       1)
           I
           I
   74.00   *********** (       2)
           I
           I
   75.00   ****** (       1)
           I
           I
   77.00   *************************** (       5)
           I
           I
   79.00   ************************************** (       7)
           I
           I
   80.00   **************** (       3)
           I
           I
   81.00   **************** (       3)
           I
           I
   82.00   *************************** (       5)
           I
           I
   83.00   ************************************** (       7)
           I
           I
           I.........I.........I.........I.........I.........I
           0         2         4         6         8        10
           FREQUENCY
```

MEAN	79.371	STD ERR	0.558	MEDIAN	79.667
MODE	79.000	STD DEV	3.300	VARIANCE	10.887
KURTOSIS	0.572	SKEWNESS	-0.958	RANGE	13.000
MINIMUM	70.000	MAXIMUM	83.000		

VALID CASES 35 MISSING CASES 0

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BN

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	1.00	9	25.7	25.7	25.7
	2.00	11	31.4	31.4	57.1
	3.00	6	17.1	17.1	74.3
	4.00	4	11.4	11.4	85.7
	5.00	5	14.3	14.3	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

```
BN
     CODE
          I
     1.00 *********************** (      9)
          I
          I
     2.00 **************************** (     11)
          I
          I
     3.00 *************** (      6)
          I
          I
     4.00 ********** (      4)
          I
          I
     5.00 ************* (      5)
          I
          I
          I.........I.........I.........I.........I.........I
          0         4         8        12        16        20
          FREQUENCY
```

MEAN	2.571	STD ERR	0.233	MEDIAN	2.273
MODE	2.000	STD DEV	1.378	VARIANCE	1.899
KURTOSIS	-0.882	SKEWNESS	0.558	RANGE	4.000
MINIMUM	1.000	MAXIMUM	5.000		

VALID CASES 35 MISSING CASES 0

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BH

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	11	31.4	31.4	31.4
	1.00	2	5.7	5.7	37.1
	2.00	8	22.9	22.9	60.0
	3.00	8	22.9	22.9	82.9
	4.00	1	2.9	2.9	85.7
	5.00	5	14.3	14.3	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BH

```
     CODE
          I
     0.00 ***************************** (     11)
          I
          I
     1.00 ****** (      2)
          I
          I
     2.00 ********************* (      8)
          I
          I
     3.00 ********************* (      8)
          I
          I
     4.00 **** (      1)
          I
          I
     5.00 ************** (      5)
          I
          I
          I.........I.........I.........I.........I.........I
          0         4         8        12        16        20
          FREQUENCY
```

MEAN	2.029	STD ERR	0.294	MEDIAN	2.063
MODE	0.000	STD DEV	1.740	VARIANCE	3.029
KURTOSIS	-0.986	SKEWNESS	0.309	RANGE	5.000
MINIMUM	0.000	MAXIMUM	5.000		

VALID CASES 35 MISSING CASES 0

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BV

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	3	8.6	8.6	8.6
	1.00	2	5.7	5.7	14.3
	2.00	4	11.4	11.4	25.7
	3.00	11	31.4	31.4	57.1
	4.00	1	2.9	2.9	60.0
	5.00	14	40.0	40.0	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BV

```
     CODE
           I
     0.00  *********  (      3)
           I
           I
     1.00  ******  (      2)
           I
           I
     2.00  ***********  (      4)
           I
           I
     3.00  ****************************  (     11)
           I
           I
     4.00  ****  (      1)
           I
           I
     5.00  **********************************  (     14)
           I
           I
           I.........I.........I.........I.........I.........I
           0         4         8        12        16        20
           FREQUENCY
```

MEAN	3.343	STD ERR	0.278	MEDIAN	3.273
MODE	5.000	STD DEV	1.644	VARIANCE	2.703
KURTOSIS	-0.623	SKEWNESS	-0.589	RANGE	5.000
MINIMUM	0.000	MAXIMUM	5.000		

VALID CASES 35 MISSING CASES 0

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BM1

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	2	5.7	5.7	5.7
	1.00	33	94.3	94.3	100.0
	TOTAL	35	100.0	100.0	

- -

```
EPA SELECTION CRITERIA

FILE    NONAME    (CREATION DATE = 01/16/84)

BM1
       CODE
             I
       0.00  *** (      2)
             I
             I
       1.00  ********************************** (     33)
             I
             I
             I.........I.........I.........I.........I.........I
             0        10        20        30        40        50
             FREQUENCY

MEAN            0.943     STD ERR         0.040     MEDIAN          0.970
MODE            1.000     STD DEV         0.236     VARIANCE        0.055
KURTOSIS       14.752     SKEWNESS       -3.989     RANGE           1.000
MINIMUM         0.000     MAXIMUM         1.000

VALID CASES       35      MISSING CASES       0
```

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BM2

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	10	28.6	28.6	28.6
	1.00	25	71.4	71.4	100.0
	TOTAL	35	100.0	100.0	

- -

```
EPA SELECTION CRITERIA

FILE    NONAME    (CREATION DATE = 01/16/84)

BM2
       CODE
             I
       0.00  ********** (     10)
             I
             I
       1.00  ************************** (     25)
             I
             I
             I.........I.........I.........I.........I.........I
             0        10        20        30        40        50
             FREQUENCY

MEAN            0.714     STD ERR         0.077     MEDIAN          0.800
MODE            1.000     STD DEV         0.458     VARIANCE        0.210
KURTOSIS       -1.082     SKEWNESS       -0.992     RANGE           1.000
MINIMUM         0.000     MAXIMUM         1.000

VALID CASES       35      MISSING CASES       0
```

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BM3

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	2	5.7	5.7	5.7
	1.00	33	94.3	94.3	100.0
	TOTAL	35	100.0	100.0	

\- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BM3

```
     CODE
          I
     0.00 *** (      2)
          I
          I
     1.00 ********************************** (     33)
          I
          I
          I.........I.........I.........I.........I.........I
          0        10        20        30        40        50
          FREQUENCY
```

MEAN	0.943	STD ERR	0.040	MEDIAN	0.970
MODE	1.000	STD DEV	0.236	VARIANCE	0.055
KURTOSIS	14.752	SKEWNESS	-3.989	RANGE	1.000
MINIMUM	0.000	MAXIMUM	1.000		

VALID CASES 35 MISSING CASES 0

\- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BM4

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	23	65.7	65.7	65.7
	1.00	12	34.3	34.3	100.0
	TOTAL	35	100.0	100.0	

\- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

```
BM4
     CODE
          I
     0.00 *********************** (     23)
          I
          I
     1.00 ************ (     12)
          I
          I
          I.........I.........I.........I.........I.........I
          0        10        20        30        40        50
          FREQUENCY
```

MEAN	0.343	STD ERR	0.081	MEDIAN	0.261
MODE	0.000	STD DEV	0.482	VARIANCE	0.232
KURTOSIS	-1.617	SKEWNESS	0.692	RANGE	1.000
MINIMUM	0.000	MAXIMUM	1.000		

VALID CASES 35 MISSING CASES 0

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BM5

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	34	97.1	97.1	97.1
	1.00	1	2.9	2.9	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

```
BM5
     CODE
          I
     0.00 ********************************** (     34)
          I
          I
     1.00 ** (     1)
          I
          I
          I.........I.........I.........I.........I.........I
          0        10        20        30        40        50
          FREQUENCY
```

MEAN	0.029	STD ERR	0.029	MEDIAN	0.015
MODE	0.000	STD DEV	0.169	VARIANCE	0.029
KURTOSIS	35.000	SKEWNESS	5.916	RANGE	1.000
MINIMUM	0.000	MAXIMUM	1.000		

VALID CASES 35 MISSING CASES 0

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BM6

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	34	97.1	97.1	97.1
	1.00	1	2.9	2.9	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BM6

```
    CODE
          I
    0.00  ********************************** (     34)
          I
          I
    1.00  ** (      1)
          I
          I
          I.........I.........I.........I.........I.........I
          0        10        20        30        40        50
          FREQUENCY
```

MEAN	0.029	STD ERR	0.029	MEDIAN	0.015
MODE	0.000	STD DEV	0.169	VARIANCE	0.029
KURTOSIS	35.000	SKEWNESS	5.916	RANGE	1.000
MINIMUM	0.000	MAXIMUM	1.000		

VALID CASES 35 MISSING CASES 0

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

BM7

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	23	65.7	65.7	65.7
	1.00	12	34.3	34.3	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE   NONAME   (CREATION DATE = 01/16/84)

BM7

```
     CODE
           I
     0.00  ************************ (     23)
           I
           I
     1.00  ************ (     12)
           I
           I
           I.........I.........I.........I.........I.........I
           0        10        20        30        40        50
           FREQUENCY
```

```
MEAN           0.343     STD ERR        0.081     MEDIAN         0.261
MODE           0.000     STD DEV        0.482     VARIANCE       0.232
KURTOSIS      -1.617     SKEWNESS       0.692     RANGE          1.000
MINIMUM        0.000     MAXIMUM        1.000

VALID CASES      35      MISSING CASES      0
```

- -

EPA SELECTION CRITERIA

FILE   NONAME   (CREATION DATE = 01/16/84)

LC1

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	9	25.7	25.7	25.7
	1.00	26	74.3	74.3	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE   NONAME   (CREATION DATE = 01/16/84)

LC1

```
     CODE
           I
     0.00  ********** (     9)
           I
           I
     1.00  ************************** (     26)
           I
           I
           I.........I.........I.........I.........I.........I
           0        10        20        30        40        50
           FREQUENCY
```

```
MEAN           0.743     STD ERR        0.075     MEDIAN         0.827
MODE           1.000     STD DEV        0.443     VARIANCE       0.197
KURTOSIS      -0.693     SKEWNESS      -1.162     RANGE          1.000
MINIMUM        0.000     MAXIMUM        1.000

VALID CASES      35      MISSING CASES      0
```

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

LC2

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	2	5.7	5.7	5.7
	1.00	33	94.3	94.3	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

LC2

```
     CODE
          I
     0.00 *** (      2)
          I
          I
     1.00 ********************************** (     33)
          I
          I
          I.........I.........I.........I.........I.........I
          0        10        20        30        40        50
          FREQUENCY

MEAN            0.943      STD ERR      0.040      MEDIAN        0.970
MODE            1.000      STD DEV      0.236      VARIANCE      0.055
KURTOSIS       14.752      SKEWNESS    -3.989      RANGE         1.000
MINIMUM         0.000      MAXIMUM      1.000

VALID CASES       35       MISSING CASES     0
```

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

LC3

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	3	8.6	8.6	8.6
	1.00	32	91.4	91.4	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

```
LC3
     CODE
          I
     0.00 **** (      3)
          I
          I
     1.00 ******************************** (     32)
          I
          I
          I.........I.........I.........I.........I.........I
          0        10        20        30        40        50
          FREQUENCY

MEAN           0.914    STD ERR      0.048    MEDIAN       0.953
MODE           1.000    STD DEV      0.284    VARIANCE     0.081
KURTOSIS       8.029    SKEWNESS    -3.094    RANGE        1.000
MINIMUM        0.000    MAXIMUM      1.000

VALID CASES      35     MISSING CASES    0
```

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

LC4

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	12	34.3	34.3	34.3
	1.00	23	65.7	65.7	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

```
LC4
     CODE
          I
     0.00 ************ (     12)
          I
          I
     1.00 *********************** (     23)
          I
          I
          I.........I.........I.........I.........I.........I
          0        10        20        30        40        50
          FREQUENCY

MEAN           0.657    STD ERR      0.081    MEDIAN       0.739
MODE           1.000    STD DEV      0.482    VARIANCE     0.232
KURTOSIS      -1.617    SKEWNESS    -0.692    RANGE        1.000
MINIMUM        0.000    MAXIMUM      1.000

VALID CASES      35     MISSING CASES    0
```

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

OF

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	0.00	24	68.6	68.6	68.6
	1.00	11	31.4	31.4	100.0
	TOTAL	35	100.0	100.0	

- -

EPA SELECTION CRITERIA

FILE NONAME (CREATION DATE = 01/16/84)

OF

```
     CODE
          I
     0.00 ************************* (    24)
          I
          I
     1.00 ************ (    11)
          I
          I
          I.........I.........I.........I.........I.........I
          0        10        20        30        40        50
          FREQUENCY
```

MEAN	0.314	STD ERR	0.080	MEDIAN	0.229
MODE	0.000	STD DEV	0.471	VARIANCE	0.222
KURTOSIS	-1.383	SKEWNESS	0.836	RANGE	1.000
MINIMUM	0.000	MAXIMUM	1.000		

VALID CASES 35 MISSING CASES 0

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